

What is claimed is:

1. A semiconductor device manufacturing method comprising the steps of:

5 preparing a semiconductor substrate having a connecting pad on an element forming surface;

forming a seed metal film to cover the connecting pad on the semiconductor substrate;

10 forming a bump metal film as a pattern having an opening portion in a predetermined portion on an area of the seed metal film that corresponds to the connecting pad;

15 forming a through hole, which is communicated with the opening portion of the bump metal film and passes through to a back surface of the semiconductor substrate, by etching sequentially the seed metal film, the connecting pad, and the semiconductor substrate located under the opening portion of the bump metal film, while using the bump metal film as a mask;

20 reducing a thickness of the semiconductor substrate by grinding the back surface of the semiconductor substrate;

25 forming selectively an insulating film to cover at least the semiconductor substrate on a side surface of the through hole before or after the step of reducing a thickness of the semiconductor substrate;

forming a conductive film in the opening portion of the bump metal film and the through hole by an

electroplating, which utilizes the seed metal film and the bump metal film connected to the seed metal film as a plating power-supply layer, to provide a through wiring which is connected to the bump metal film and whose connection terminal is exposed on a back surface side of the semiconductor substrate; and

5 forming a metal bump by etching the seed metal film while using the bump metal film as a mask.

10 2. A semiconductor device manufacturing method comprising the steps of:

preparing a semiconductor substrate having a connecting pad on an element forming surface;

forming a seed metal film to cover the connecting pad on the semiconductor substrate;

15 forming a bump metal film as a pattern having an opening portion in a predetermined portion on an area of the seed metal film that corresponds to the connecting pad;

20 forming a hole, which is communicated with the opening portion of the bump metal film and does not pass through the semiconductor substrate, by etching the seed metal film and the connecting pad located under the opening portion of the bump metal film and then etching the semiconductor substrate to a middle of a thickness, 25 while using the bump metal film as a mask;

grinding the back surface of the semiconductor substrate to reduce a thickness of the semiconductor

substrate and also expose the hole to obtain a through hole;

5 forming selectively an insulating film to cover at least the semiconductor substrate on a side surface of the through hole;

10 forming a conductive film in the opening portion of the bump metal film and the through hole by an electroplating, which utilizes the seed metal film and the bump metal film connected to the seed metal film as a plating power-supply layer, to provide a through wiring which is connected to the bump metal film and whose connection terminal is exposed on a back surface side of the semiconductor substrate; and

15 forming a metal bump by etching the seed metal film while using the bump metal film as a mask.

3. A semiconductor device manufacturing method comprising the steps of:

preparing a semiconductor substrate having a connecting pad on an element forming surface;

20 forming a seed metal film to cover the connecting pad on the semiconductor substrate;

25 forming a bump metal film as a pattern having an opening portion in a predetermined portion on an area of the seed metal film that corresponds to the connecting pad;

forming a hole, which is communicated with the opening portion of the bump metal film and does not pass

through the semiconductor substrate, by etching the seed metal film and the connecting pad located under the opening portion of the bump metal film and then etching the semiconductor substrate to a middle of a thickness 5 while using the bump metal film as a mask;

forming selectively an insulating film to cover at least the semiconductor substrate on a side surface of the hole;

10 forming a conductive film in the opening portion of the bump metal film and the hole by an electroplating, which utilizes the seed metal film and the bump metal film connected to the seed metal film as a plating power-supply layer;

15 providing a through wiring, which is connected to the bump metal film and whose connection terminal is exposed on a back surface side of the semiconductor substrate, by grinding the back surface of the semiconductor substrate until the conductive film formed in the hole is exposed; and

20 forming a metal bump by etching the seed metal film while using the bump metal film as a mask.

4. A semiconductor device manufacturing method according to any one of claims 1 to 3, wherein the step of forming a bump metal film as a pattern, includes the 25 steps of,

forming a masking layer having an opening portion and an island-like pattern, which is arranged in

a predetermined portion on the opening portion, on an area of the seed metal film corresponding to the connecting pad,

5 forming the bump metal film in the opening portion of the masking layer by an electroplating utilizing the seed metal film as the plating power-supply layer, or an electroless plating,

10 exposing the opening portion of the bump metal film by removing selectively the island-like pattern of the masking layer, and

further comprising the step of:

removing the masking layer prior to the step of forming the metal bump.

15 5. A semiconductor device manufacturing method according to claim 1 or 2, wherein the step of forming selectively the insulating film, includes the steps of,

pasting a protection film, which fills at least the opening portion of the bump metal film, on the element forming surface of the semiconductor substrate,

20 forming an insulating film on a side surface of the through hole and a lower surface of the protection film that is filled in the opening portion of the bump metal film, and

25 releasing the protection film from the semiconductor substrate to lift off the insulating film formed on the lower surface of the protection film and thus leave selectively the insulating film on a side

surface of the through hole in the semiconductor substrate.

6. A semiconductor device manufacturing method according to claim 3, wherein the step of forming 5 selectively the insulating film, includes the steps of,

forming the insulating film to cover the opening portion of the bump metal film and the hole,

10 forming a masking layer that fills at least the hole but exposes the opening portion of the bump metal film,

etching the insulating film while using the masking layer as a mask so as to leave selectively the insulating film on a side surface of the hole in the semiconductor substrate, and

15 removing the masking layer.

7. A semiconductor device manufacturing method according to any one of claims 1 to 3, wherein the bump metal film is formed of any one selected from a group of 20 consisting of a gold film, a copper film, a solder film, and a laminated film composed of a nickel film/a gold film.

25 8. A semiconductor device manufacturing method according to any one of claims 1 to 3, wherein, in the step of grinding the semiconductor substrate, a thickness of the semiconductor substrate is set to about 150  $\mu\text{m}$  or less.

9. A semiconductor device manufacturing method

according to claim 2 or 3, wherein, in the step of forming the hole, the semiconductor substrate is etched such that a depth of the hole is set to about 150  $\mu\text{m}$  or less.

5 10. A semiconductor device manufacturing method according to any one of claims 1 to 3, wherein the through wiring is formed to fill the opening portion of the bump metal film and the through hole.

10 11. A semiconductor device manufacturing method according to any one of claims 1 to 3, wherein the through wiring is formed in a state that a cavity is provided in center portions of the opening portion of the bump metal film and the through hole.